UTAH DEPARTMENT OF TRANSPORTATION

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Dowel Bar Retrofit

The purpose of a Dowel Bar Retrofit (DBR) is to restore the load transfer from one slab to another at joints and cracks in concrete pavement. Joints with poor load transfer begin to exhibit faulting, the difference in elevation between slabs, at joints or cracks. It starts when a heavy loads cross a joint or crack, inducing high deflections at the slab corners and pumps the support material from under the slab or moves it from one side of the joint to the other. Applying DBR to these pavements extends their life by eliminating the high deflections at the slab corners by restoring the load transfer. DBR consists of sawing slots across transverse joints or cracks, cleaning the slot, injecting caulking filler, placing a reinforcing steel dowel in the slot, filling the slot with a patching material, and establishing a joint by saw cut. DBR will extend the life of the concrete pavement by an estimated 10 to 15 years.

PROPER APPLICATION

Trigger values to be used as a guide to restore load transfer for concrete rehabilitation using DBR are as follows. (Note – slab cracking is defined as the percent of panels that are cracked into 3 or more pieces):

If average joint faulting is < 1/8 inch and slab cracking is # 10 percent – Do nothing.
If average joint faulting is $1/8 inch and < ½ inch and slab cracking # 10 percent – DBR.
If average joint faulting is $1/2 inch, slab cracking # 10 percent, and ADT # 50,000 – DBR.
If average joint faulting is $1/2 inch, slab cracking # 10 percent, and ADT $ 50,000 – Reconstruct.
If cracking is > 10 percent – Reconstruct.
If pumping is present, irrespective of faulting or cracking, DBR should be considered.

SPECIFICATIONS/DETAILS

DBR is a relatively simple procedure that consists of five main operations: 1. Cutting the slots, 2. Preparing the slots, 3. Placing the dowel bars, 4. Back-filling the slots, 5. Diamond grind if required for smoothness.

The cutting of the slots is best accomplished using a diamond-saw slot cutter. The saw head is placed before the joint or crack, then plunged into the concrete and advanced across the joint or crack. Typically, the saw operator must make more than one plunge to cut the slot to its required depth. The slot must be long enough to allow the dowel to sit at the bottom of the slot without its ends hitting the curves of the saw cuts.

The slot preparation consists of removing the fins, flattening the bottom of the slots, cleaning the slots, and caulking the joints or cracks. To remove the fins after sawing, use a hand-held jackhammer no heavier than 30 pounds to chip out the concrete. Flatten out the bottom of the cut by attaching a small hammerhead bit to

the jackhammer. This removes rocks and stubble from the slot bottom. Rocks and stubble can prevent proper dowel alignment by keeping the dowel from sitting level. They can also prevent the patching material from completely encasing the dowel. Improper dowel alignment and incomplete encasement can result in pavement lockup or dowel socketing. Dowel socketing being the widening of the dowel hole, which leads to loss of load transfer.

The dowels used for retrofitting are the same as those used for new concrete pavement construction, with a few modifications. Their minimum length is 14 inches, 18 inches being the most common, and must be long enough to have at least 6 inches on each side of the joint or crack being repaired when placed in the slot. The dowels should also be 100% epoxy coated, including the ends. Before placing it into the slot, fit the dowel with a ¼ inch nonmetallic expansion caps, a plastic foam or filler-board joint reformer, and non-metallic chairs. The expansion caps allow the joint to open and close after installation. Placed at the dowel midpoint, the plastic foam joint reformer also allows slab movement by keeping patching material out of the joint. Non-metallic chairs are placed at each end of the dowel to lift the dowel ½ inch off the slot bottom, and the dowel bar ends should be at least ½ inch away from the saw cut or slot ends. Before placing the dowel in the slot, cover it with a debonding agent such as form oil or grease so that it can move within the patch after it has hardened, however make sure that no oil or grease falls onto any of the slot surfaces.

Generally, any material that works for a partial-depth repair should work as a patch material for a DBR. To place the patch material, shovel the concrete into the slot and consolidate it in the slot and around the dowel bar with a spud vibrator. Be careful not to hit the dowel bar with the vibrator when placing the patch material. This may knock the dowel out of alignment. A curing compound may also be required depending on the evaporation conditions. The finish of the patch usually is not crucial since the entire pavement surface is usually diamond ground shortly after the DBR is complete.

UDOT specification 02754S has been used for a DBR on project number ***IM-215-9(108)4**

COST INFORMATION

The average construction costs for DBR is approximately $320,000 (2001 dollars) per lane mile (includes all costs – PE, construction, traffic control, etc).

FURTHER INFORMATION

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ACPA DBR Information:
http://www.pavement.com/Downloads/RP335P.pdf
ACPA – Faulting issues discussed:
http://www.pavement.com/techserv/RTUpdate09.pdf
California DBR specification
http://www.igga.net/specs/CA_DBR_40-015_A02-15-01.pdf